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Angler survey and catch census Kouchibouguac National Park

1990, 1991, 1992 and 1996

Gary Corbett,
Léophane LeBlanc,
Marco Dussault, and
Eric Tremblay

October, 2000
Report 022

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Parks Canada - Technical Reports in Ecosystem Science

Report 022

Angler Survey and Catch Census Kouchibouguac National Park, New Brunswick

1990, 1991, 1992 and 1996

by

Gary Corbett [1], Léophane LeBlanc [2], Marco Dussault [2], and Eric Tremblay [2]

October, 2000

[1] Ecosystem Management, Parks Canada
Halifax, Nova Scotia

[2] Kouchibouguac National Park,
Richibucto, New Brunswick

Canadian Cataloguing in Publication Data

Corbett G., L. LeBlanc, M. Dussault and E. Tremblay

Angler survey and catch census
Kouchibouguac National Park
1990, 1991, 1992 and 1996

(Parks Canada - technical report in ecosystem science,
ISSN 1200-3298; report no. 22)
Includes an abstract in French.
Includes bibliographic references

ISBN 0-662-28577-8
Catalogue No. R61-2/19-22-2000E

1. Fishing surveys – New Brunswick – Kouchibouguac National Park
2. Fishing – Catch effort – New Brunswick – Kouchibouguac National Park
3. Wildlife-related recreation surveys – New Brunswick – Kouchibouguac National Park
I. Corbett, Gary Neil, 1952-
II. Parks Canada. Atlantic Region.
III. Series: Technical reports in ecosystem science; no. 22.

SH328.A53 2000 333.95'6'0971522 C00-980071-9

Published by authority of the Minister of Canadian Heritage
© Her Majesty the Queen in Right of Canada, represented by
the Chief Executive Officer of Parks Canada, 2000

ISSN 1200-3298; report no. 22
ISBN 0-662-28577-8
Catalogue No. R61-2/19-22-2000E

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Abstract

A roving angler survey and catch census (creel census) was conducted in Kouchibouguac National Park, New Brunswick, Canada in 1990, 1991, 1992 and 1996. Anglers were interviewed while fishing and asked questions concerning residency, fishing methods, time spent fishing, success and catch. Other pertinent information such as tide and weather conditions was also collected. Individual fish were identified to species, weighed, and measured. Most angling occurs in two of the major river systems flowing seaward through the park; the Kouchibouguac River and the Black River. Local fishermen account for 65% of the angling licenses sold annually but catch most of the annual brook trout *(Salvelinus fontinalis)* harvest from mid May to mid June. Few non-local anglers were encountered during the census, however, most non-resident angling occurs in summer and very little is caught. Most local anglers fish in the same location every trip and both effort and catch increase from late April, peak in mid May, then decline to early June. Most angling occurred on the falling tide, when catch rates were lower. The mean catch per hour on the rising tide in 1996 was 0.42 while that for falling tides was 0.34. Overall, success was better on sunny days with a northwest to southwest wind (catch per hour 0.50) than on cloudy days with a south to east wind (catch per hour 0.20). Over the four years censused the best success was in 1991 with anglers on the Black River averaging 1.2 trout per angler per hour (CPUE). Catch per unit of effort (CPUE) was significantly better in 1991 than any of the other three years; however, CPUE in 1996 was not significantly different than in 1992. During 1991, 1992 and 1996, anglers caught consistently more trout per hour in the Black River however they were significantly smaller (χ = 20.5 cm, n= 135) than those caught in the Kouchibouguac River (χ = 23.2 cm, n=207). Average fish size may account for the fact that little angling occurred in the Black River during years when the success rate was not dramatically different in the two rivers. Trophy size trout, 4 to 5 years of age, over a kg in weight and up to 42 cm long can be caught in either river. Atlantic salmon *(Salmo salar)* were recorded caught only in the Kouchibouguac River. The 1996 census recorded no salmon caught even though the census took place during the period when salmon are caught. No significant difference was found in the population structure, catch, effort and other parameters in the trout fishery between years in either the Black or Kouchibouguac rivers. The brook trout population appears to be healthy based on age class strength and CPUE. There are presently no grounds upon which to make changes in the trout fishery. A striped bass *(Morone saxatilis)* catch census was conducted in 1992. Bass were caught between mid August and late September in both rivers with a mean catch per hour of 1.82. Fifty-five bass were sampled ranging in length from 16.7 to 40.7 cm fork length with a mean of 27.5 cm. Insufficient creel census data were available to evaluate the striped bass or the Atlantic salmon populations in either river system.

Résumé

Une enquête auprès des pêcheurs et un relevé des prises ont été effectués sur le terrain dans le parc national Kouchibouguac, au Nouveau-Brunswick, au Canada, en 1990, 1991, 1992 et 1996. Les pêcheurs ont été interviewés alors qu'ils pêchaient, et les questions portaient sur le lieu de résidence, les méthodes de pêche, le temps consacré à la pêche, le taux de succès et les prises. D'autres informations pertinentes, comme les marées et les conditions météorologiques, ont également été recueillies. Les poissons capturés ont été recensés selon l'espèce, le poids et la taille. La pêche se pratique surtout dans deux des grandes rivières qui traversent le parc en direction de la mer : la rivière Kouchibouguac et la rivière Black. Les pêcheurs locaux achètent pour 65 % des permis de pêche vendus chaque année et capturent presque toute la récolte annuelle d'omble de fontaine *(Salvelinus fontinalis)* de la mi-mai à la mi-juin. Le relevé a permis de recenser quelques pêcheurs qui n'étaient pas de la région, mais c'est surtout en été qu'on dénombre des pêcheurs d'ailleurs, et les prises sont peu nombreuses. La majorité des pêcheurs locaux pêchent au même endroit à chaque sortie de pêche. L'effort de pêche et le nombre de prises augmentent à la fin avril, pour atteindre un sommet à la mi-mai, puis diminuer au début de juin. On a constaté que la pêche se pratiquait surtout à la marée descendante, quand les taux de prise étaient peu élevés. Le taux de prise horaire moyen à la marée montante était de 0,42 en 1996, tandis qu'il était de 0,34 à la marée descendante. La pêche était en général meilleure par temps ensoleillé, lorsque le vent soufflait du nord-ouest en direction du sud-ouest (taux de prise horaire : 0,50), que par temps couvert avec un vent du sud soufflant en direction de l'est (taux de prise horaire : 0,20). On a également constaté que, au cours des quatre années où le relevé a été effectué, c'est en 1991 qu'on a enregistré le taux de succès de pêche le plus élevé, avec un taux de prise horaire moyen de 1,2 (truite) dans la rivière Black (PUE). Les prises par unité d'effort (PUE) étaient nettement supérieures en 1991 par rapport aux trois autres années, tandis que, en 1996, il y avait peu de différence avec les PUE de 1992. En 1991, 1992 et 1996, les pêcheurs ont capturé de façon constante un plus grand nombre de truites à l'heure dans la rivière Black, mais les poissons étaient beaucoup plus petits (taille moyenne : 20,5 cm pour 135 poissons) que ceux qui avaient été pêchés dans la rivière Kouchibouguac (taille moyenne : 23,2 cm pour 207 poissons). La taille moyenne des poissons pourrait s'expliquer du fait que la pêche n'a pas été importante dans la rivière Black pendant les années où le taux de succès n'était en fait pas très différent dans les deux rivières. Il est possible de pêcher dans les deux rivières des truites trophées de 4 à 5 ans qui pèsent plus d'un kilogramme et qui peuvent mesurer jusqu'à 42 cm de longueur. On n'a relevé des prises de saumon de l'Atlantique *(Salmo salar)* que dans la rivière Kouchibouguac. Le relevé de 1996, bien qu'effectué pendant la période de pêche du saumon, n'indique aucune prise de saumon. Dans le cas de la pêche de la truite, on a relevé aucun écart important entre les années, ni dans la rivière Black ni dans la rivière Kouchibouguac, concernant la structure de la population, les prises, l'effort de pêche et les autres paramètres. La population d'ombles de fontaine semble en bonne santé, vu la taille pour la classe d'âge et les PUE. Il n'y a donc actuellement aucune raison fondée d'apporter des changements à la pratique de la pêche. Le relevé des prises de bar d'Amérique *(Morone saxatilis)* effectué en 1992 indique que des bars ont été pêchés entre la mi-août et la fin septembre dans les deux rivières, à raison d'un taux de prise horaire moyen de 1,82. On a recensé 55 bars dont la longueur à la fourche variait de 16,7 cm à 40,7 cm, ce qui donne une longueur moyenne de 27,5 cm. Il est impossible d'évaluer les populations de bars d'Amérique et de saumons de l'Atlantique dans les deux rivières en raison de l'insuffisance des données sur les prises.

Acknowledgements

We would like to acknowledge the following people who made this project possible; Firmin Leblanc completed extensive field work and data compilation, Nöel Fontaine, Gordon Delaney, Benoit Richard, Arnold Vautour, Harold Sock, Gilles Lebel, Jean Guy Goudet, Brigitte Cimon, Denise Maillet, Nadine Robichaud and Anita Doucet who conducted much of the on site angler interviews. Dan MacPhail aged 134 trout scales collected from anglers catches in 1992 and 1996. Dawn Allen developed and inserted the figures presented in the report. Thanks also go to Thomas Miko for graphic design, text formatting and editing.

We would like to thank Peter Cronin and an anonymous reviewer for their invaluable editorial comments on the manuscript.

1.0 Introduction

Fisheries, including angling, conducted within national parks must be managed for a variety of reasons. In some cases, the fishery may be a long-standing tradition within the local community with valued socio-economic factors. Some local people may depend on locally caught fish for food. Park management plans may provide for the continuation of those fisheries. The fisheries resources should be managed on a sustainable basis. Angler surveys and creel census is the process of gathering statistics on anglers catch, effort and success rate. Statistical analysis can be applied to those data if the census is properly designed, implemented and if adequate numbers of anglers of varying skills are interviewed. National Parks Policy (anon. 1994), in particular section 3.2.12, requires that fish populations, as a resource, be managed for minimal interference of natural processes, evolution and to ensure their long term viability. Management of fisheries is still far from an exact science because of the difficulty in evaluating stock characteristics. Decisions are often based on poor quality, relative information which is inadequate for the purpose. Catch/ effort sampling strategies provide a mechanism whereby the quality of information can be improved, at minimal cost to the fishery manager (Cowx 1994). Where angling is permitted in national parks the opportunity exists to gather catch/effort data. In many cases this will be the only data available to managers due to the cost of other data gathering methods and shrinking budgets.

During the interview process, other opportunities to gather valuable information present themselves. Anglers observe many things and are concerned with preserving their recreational opportunities. They may freely provide information on poachers activities or make suggestions on management or regulations. They may observe environmental impacts or have useful data on wildlife. The incidence of by-catch may provide clues about the trend of other fish species in the waterbody. The arrival of exotic species may show up in the catch and provide managers with an opportunity to eradicate the invader while it is still possible. Anglers, willing to catch and release, can be of assistance in research projects such as in migration or movement studies where fish must be tagged, released and recaptured or where tissue or blood samples are required for genetics or disease research.

Staff at Kouchibouguac National Park in New Brunswick, Canada, initiated an angler survey and creel census beginning in 1990. The objectives were: to gather demographic data on the anglers; determine how much fishing effort was being expended in each location; calculate catch per hour for a variety of individual anglers and the catch for species caught as well as age, length and weight of individual fish. Anglers were interviewed during the 1990, 1991, 1992 and 1996 fishing seasons using a roving staff method. This report describes the application of the roving creel census technique to early season recreational trout fisheries in two major river systems and several brooks within the park. The study results and conclusions are presented and some recommendations regarding future surveys are given.

2.0 Study Area

Kouchibouguac National Park (KNP) was gazetted under the National Parks Act in 1979 and covers 238 km² of forests, bogs, estuaries, open fields, and barrier dunes. The nearest large city is Moncton which lies 100 km distant to the south. Bordering on the Northumberland Strait, the park (Figure 1) is an important tourist destination as visitors come to enjoy the expansive sand beaches and warm ocean water. KNP is part of the Northumberland Strait Ecoregion (Hirvonen 1984) characterized by a relatively long frost free period and is adapted to the salt spray and wind associated with the marine environment. The topography is flat and gently slopes to sea level, resulting in slow drainage and a large number of bogs. On higher ground with better drainage, the forest is dominated by black spruce *(Picea mariana)* and balsam fir *(Abies balsamea)*. Eight major terrestrial and aquatic ecosystem types are protected: Acadian forest (51%), bogs (23%), freshwater streams and lakes (less than 1%), lagoons and estuaries (17%), salt marshes (3.6%), sandy barrier islands and spits (2%), and ocean. This ecoregion is also defined by the presence of sand dune and beach systems (Kalff 1998). The park's eastern boundary is a 25 km marine coastline with park jurisdiction extending to the mean high tide line allowing it to also be classified under the Atlantic Ocean - Magdalene Shallows Natural Marine Region. The Magdalene Shallows natural marine region is a pocket of warm water (less than 100 m deep) in the southwest section of the Gulf of St. Lawrence. Large areas of sand and gravel cover the bottom, some of which is actively moved by waves and currents.

There are 39 drainage systems wholly or partially within the park (Ambler 1975). Two major rivers, the Kouchibouguacis and the Kouchibouguac are tidal within the park and there are six smaller but important streams: Portage River, Polly's Creek, Fontaine River, Black River, Rankin Brook and Major Kollock Creek (Figure 2). Only Major Kollock Creek and Polly's Creek are contained largely within park boundaries. Major parts of these systems are estuarine and estuaries cover 4275 ha, or 18% of the park. Brooks within the park are small and exhibit a wide variation in water flow due to seasonal precipitation. They are also humic since headwaters are bogs and fens creating many acidic conditions with pH ranging from 4.7 to 7.6. Iron and manganese are naturally high, while nutrients are generally low. The sediment load of the rivers is naturally low due to gentle channel slopes, a high percentage of forest cover, entrapment provided by numerous bogs, and little soil disturbance combine to limit sediment loadings (Kalff 1998). The two major river systems involved in this study; the Kouchibouguac and Black rivers have total drainage areas of 393 km² and 51 km² respectively. The Black River is also estuarine (tidal) for much of it's extent within park boundaries particularly where angling occurs and it's total length is 30 km (Ambler 1975). KNP supports 30 species of fish. Anadromous species include Atlantic salmon *(Salmo salar)*, rainbow smelt *(Osmerus mordax)*, brook trout *(Salvelinus fontinalis)*, gaspereaux *(Alosa pseudoharengus)*, and striped bass *(Morone saxatilis)*, while the catadromous eel *(Anguilla rostrata)* is common. Much of the fish diversity is found in the productive estuaries. Migration of anadromous and catadromous species occurs through the gullies which separate the barrier dune islands (Kalff 1998). The angler survey and catch census conducted for this study was carried out at the Kouchibouguac River, Black River and minor samples collected from anglers at Rankin Brook, Fontaine Creek and Portage River.

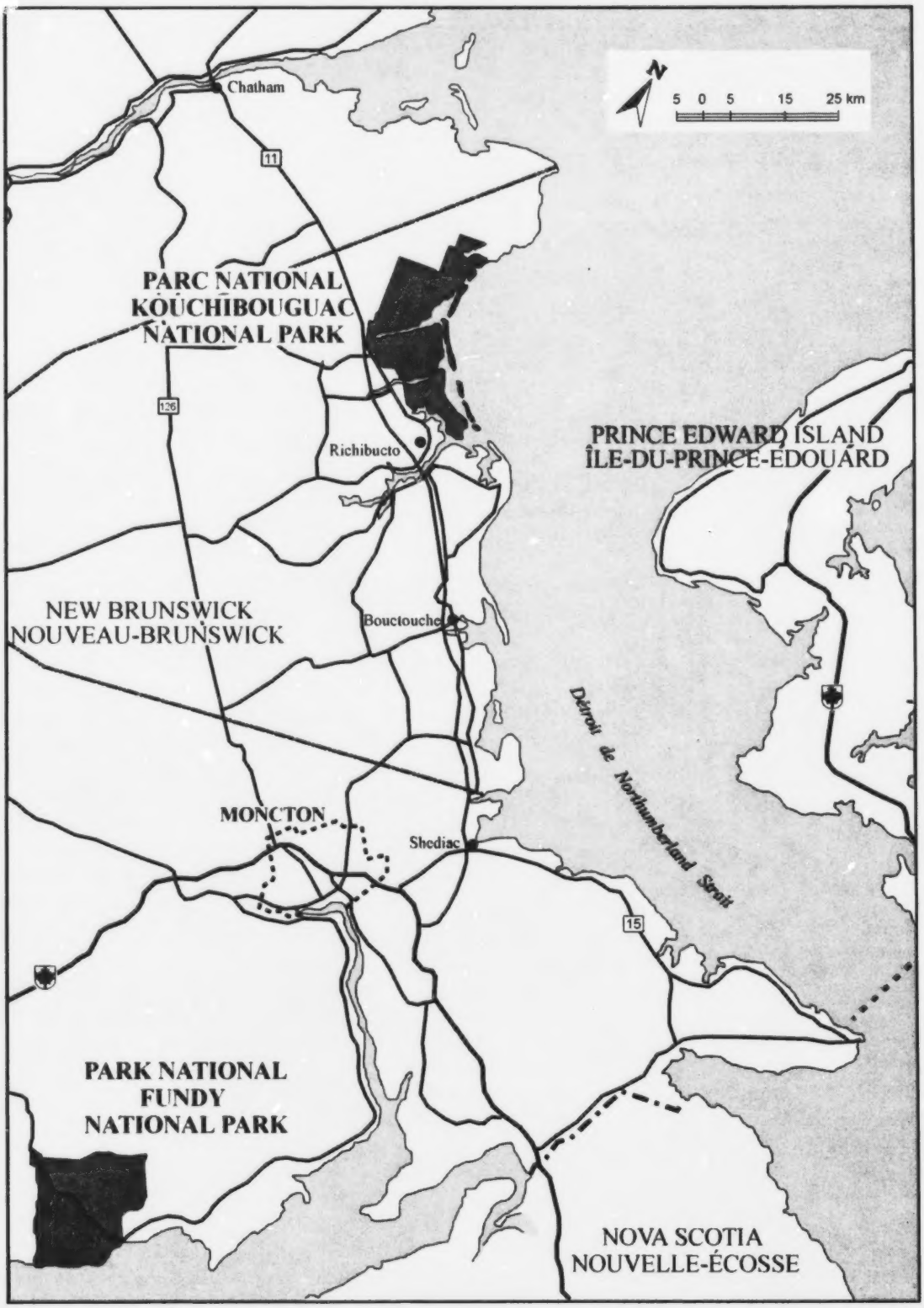

Figure 1. Kouchibouguac National Park in a regional setting.

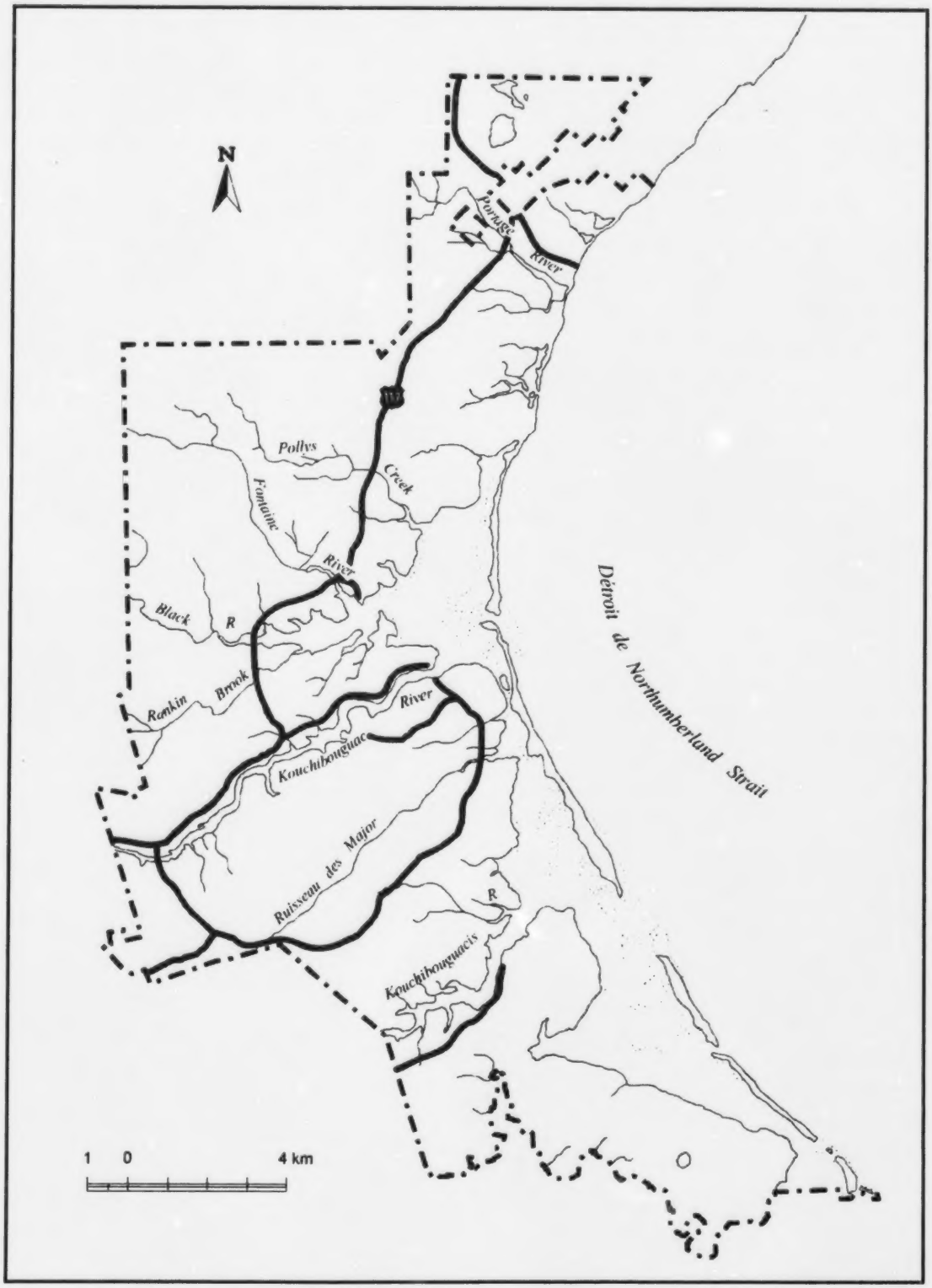

Figure 2. Major drainage systems of Kouchibouguac National Park.

3.0 Methodology

3.1 Selection of Survey Sites

Park Wardens used personal knowledge, local knowledge from residents and patrols to determine where angling for trout and other species occurred in KNP. Only locations where anglers fish daily or at least 4 or 5 days per week during the peak fishing period mid-April through Mid-June were chosen. The majority of angling occurs in the Kouchibouguac River and Black River within a kilometer of bridges on Route 117. Anglers fish from the bridges themselves or along the river banks. Some angling occurs from boats. The most heavily fished areas are within the upper limit of tidal waters, in particular, locations in the Kouchibouguac and Black rivers. Survey crews contacted the majority of anglers by using a travel route with frequent stops along highway 117 beginning at the bridge across the Kouchibouguac River and ending at the bridge crossing the Portage River (Figure 2). Parking areas were scanned for vehicles and when found the angler(s) were located along the streams.

3.2 Timing of Surveys

Surveys were undertaken between April 20 and July 25th,when time permitted, in 1990. Only 20 days were surveyed, 10 during peak fishing in May. In 1991 surveys began on April 13 and continued through until the end of October. An attempt was made to increase the sample size and to determine when and where the majority of angling occurred. Seventy-four days were surveyed involving 55 morning periods and 28 afternoon periods. Only 3 evenings were surveyed. Over 585 hours of angling was surveyed. Since very few fish were caught until late April and after June 1st, surveys in 1992 concentrated on the April 22nd to June 1st period. Seven days in April and 16 days in May (9 with AM surveys, 9 with PM surveys, 2 evenings) were surveyed along with only 2 in June. Overall, 421 hours of angling was surveyed and the effort was concentrated during peak fishing success. A catch census for Striped Bass was conducted from mid August until mid September when staff time permitted in 1992. Only 14 catches were censused, however, valuable data resulted. In 1996, survey effort was again concentrated in May. Four hundred and twenty-seven hours of angling were surveyed over twelve randomly chosen days. Mornings and afternoons were surveyed but no evenings.

3.3 Data Collection

The roving creel census described in Malvestuto et al. (1978) or Pollock, Jones and Brown (1994) was used to collect data whereby anglers are contacted by boat or on foot. This allows anglers to be counted and interviewed regardless of where they began their fishing trip and whether they have completed their trip or not. Each day was divided up into 5 time periods of 2 hours each covering daybreak to early morning; late morning; noon period and early afternoon; late afternoon and evening to 8 PM. A month would total up to 155 of these time periods. Preliminary observations and the 1990 survey revealed that most angling was conducted by local residents who fished at variable times throughout the week. No day types (weekday vs weekend days) to compensate for additional fishing pressure on weekends was entered into the sampling scheme. It was deemed unnecessary to allocate more sampling to weekends to improve the survey efficiency (random sampling was not stratified). Time periods were randomly selected for the actual survey and where staff time permitted, as large a sample of them as possible were actually surveyed. In 1990 few time periods were sampled; in 1991 a large number of time periods were sampled throughout the fishing season (April-August); in 1992 and 1996 time periods surveyed were limited to peak fishing in May in an effort to improve the efficiency of the survey. The distribution of sampling effort was made to coincide with the distribution of the catch. Roving surveys produce estimates of catch, harvest and fishing effort. (Catch refers to all fish caught, whether kept or released, and harvest refers to fish kept; fishing effort sometimes is called fishing pressure.) Catch rate or catch per unit of effort (fish/hour) is derived from interviews, during which anglers are asked what time they started fishing and

how many fish they had caught until the time of the interview. Estimated total effort (angler-hours) in a fishing area is based on counts of anglers extrapolated to the number of hours in a fishing day.

3.4 Angler Survey Form and Databases

A survey questionnaire was devised for interviewing anglers (Figure 3). One form was completed for each major angling location each time it was surveyed. Data collected included date, name of waterbody and location within the waterbody; time and duration of the survey; number of anglers observed; number of anglers surveyed; total catch reported; fishing methods; data on fish caught by those interviewed (species, number, number kept/released, fork lengths and weights). In 1992 and 1996 individual fish in anglers creels were examined. This involved identification to species, measurement of each fish from the tip of the nose to the fork in the tail to the nearest 1/10 centimeter (fork length). Each was weighed to the nearest 1/10 gram and scale samples were taken to enable the fish to be aged. Other data collected included vehicle license numbers, names of anglers and permit numbers. Following an annual survey, the questionnaires were compiled and then the data were transferred to a dBase 3 spreadsheet. A Texasoft statistical analysis package was used to analyze the information.

KOUCHIBOUGUAC NATIONAL PARK Page __ of __

CREEL CENSUS

Date _____ 1991 Name of waterbody_____

Time _____ to _____ Location within waterbody_____

Duration of Census_____(hrs:min)

Average number of anglers observed No. of local anglers_____

during census period_____

No. of anglers censused_____

Total hours fished by all anglers censused_____

Total catch by all anglers_____

Trip complete (Yes or No)_____

Fishing Method (Boat, Trolling, Casting, Shore)_____

Type of bait (Fly, Lure, Bait or any combination)_____

FISH DATA

Species Caught	Number Caught	Number kept	Number Released	Length (cm)	Weight (grams)
-					
-					
-					
-					

REMARKS: (Weather, tide conditions, names and addresses...)

*NOTE: Use one sheet for each fisherman or party contacted.

Figure 3. Angler survey questionnaire.

4.0 Results

4.1 Angler Demographics

Between 60 and 70 percent of fishing licenses were purchased by local anglers. This trend persisted throughout the 1990's. Of 438 fishing licenses purchased in 1991, local anglers bought 280; non-local New Brunswickers bought 80; Quebecers bought 30; Ontario residents bought 20; Nova Scotians bought 6; Americans bought 15; residents of France bought 4 while Germans bought 2. It is believed that most of the non-locals fished during the summer months either hoping to catch a Striped Bass or for anything which may bite. Success was extremely poor at that time of year. The sales distribution was similar in 1992; total sales for the 1993-1995 period were 500, 371 and 388 respectively. Sales distribution in 1996 was complicated by the new requirement for recreational clammers to possess a national park fishing license. Daigle and Richard (1997) reported total sales in 1996 of 892 fishing licenses. Of those, 67.8% (605) were bought by local anglers and 12.7% (113) by non-local New Brunswickers. The proportions bought by other groups were similar to previous years: 1 sale to each of NS and PEI residents; 99 to Quebecers; 33 to Ontarians; 23 to Americans; 3 to French and 6 to German nationals. The 1992 striped bass angler survey indicated that mainly locals participated in the fishery.

4.2 Angling Methods

Most local anglers fished for trout by standing on the shoreline or from a bridge; a few fished from boats either anchored or moving (trolling). The favored rod was a spincasting outfit using live bait on a bare hook or a spinner and hook. Earthworms were the favored live bait. Anglers preferred to fish on a falling tide with 121 of 137 interviews (88.3% of the total season effort). The 1992 striped bass angler survey revealed that bass anglers use lures cast from shore or trolled from boats.

4.3 Fish Species Caught

During April, May and early June, anglers pursued brook trout, either the freshwater or sea run variety. Since most angling was done in tidal waters, a large percentage of the trout were sea run. A few Atlantic salmon ascend and descend the larger rivers of the park and were occasionally caught by trout anglers in April and May during this study. Most of these were "black salmon" returning to the sea and a few small ones were salmon parr and smolts. They were usually released back into the water. Until "catch and release" only was implemented in 1993, striped bass were actively fished for and retained in the Kouchibouguac and Black Rivers during August and September (season extends from July 1st - Oct 31st. Because many anglers use baited hooks which often lie on the bottom, a by-catch of bottom feeding fish resulted. These include white sucker *(catostomus commersoni)*, eel, tomcod *(Microgadus tomcod)* and Flounder *(Liopsetta putnami)*. Rainbow smelts were occasionally caught in top water fishing.

4.4 Year by Year Results

1990 SURVEY RESULTS

Very little can be concluded from the first survey year's data. Only 20 questionnaires were completed and few accurate trout fork lengths, no weights nor scale samples were taken. A sample of 42 catch\effort records were made, permitting some analysis. Eleven records were collected from the Black River and 31 from the Kouchibouguac River. For both rivers combined, the mean catch of trout per hour (CPUE) was 0.38. Interestingly, the separate CPUE's for each river were also 0.38 however the standard deviation for the Black was 0.61 and for the Kouchibouguac, 0.41. Forty-five percent of anglers on both rivers caught no fish when interviewed; 69% caught less than 0.5 trout per hour and 95% caught less than 1 trout per hour. The best CPUE was only 2.0.

1991 SURVEY RESULTS

The 1991 survey yielded 362 records (all local except 9 non-local New Brunswick) from 71 different license holders. These records covered 106 different fishing trips in April, 60 in May, 11 in June, 2 in July, 3 in August and 4 in September. These were 321.6 hours surveyed in April, 212.5 in May, 32 in June, 6.5 in July, 5.5 in August and 7.1 in September. A total of 247 brook trout, 4 Atlantic salmon grilse and 10 large Atlantic salmon were recorded. Most of the trout were retained. One angler caught 110 brook trout between April 13 and August 14th as well as 11 Atlantic salmon between April 13 and May 19th. This represented almost 1/2 of the total catch surveyed that year. The angler's mean trout CPUE for 110.6 hours fishing was 1 trout per hour. The best CPUE was on May 10 at the Black River bridge with a catch of 3.7 fish per hour comprised of 9 trout and 2 salmon. On June 26th the same angler had a CPUE of 2.8 at the same location. The best CPUE of the survey was an angler who fished only 2 days but caught 18 trout in 4 hours in mid May for a CPUE of 4.5. Other anglers did not fare so well; 18% caught nothing, 45% had CPUEs of less than 0.5, 69% had CPUEs of less than 1.0. There were 11 records reporting a CPUE of 2.0 or more. Thirty-one license holders surveyed, fished only once, mostly in April, and caught nothing. In general, most anglers caught nothing during the first 3 weeks of April. During the last week of April, anglers typically caught 1 trout in 5 or 6 hours of fishing. Success picked up during May peaking at 2 or more trout per hour. By early June, most anglers had quit fishing. The season mean CPUE for the Black River was 1.2 (sd=1.22, n=43) and for the Kouchibouguac River it was 0.67 (sd=.79, n=26). For both rivers combined, the May CPUE was 0.92 (196 trout in 212.5 hrs).

1992 SURVEY RESULTS

The 1992 survey yielded 106 records (87 local anglers and 19 non-local New Brunswick) for a total of 420.9 hours of fishing. One hundred and nineteen trout were caught for a mean CPUE of 0.28. Survey data from local anglers totaled 348.9 hrs with a catch of 98 trout and a CPUE of 0.28. Non-local New Brunswick angler survey data totaled 72 hrs and a catch of 21 trout for a CPUE of 0.29. Local angler CPUE for April was 0.08 and for May it was 0.61. The survey was strongly biased towards April data, therefore, to enable comparisons with other years where most surveys were completed in May, most of the April records were dropped from the spreadsheet for a further exercise. This left a similar data distribution as the 1991 data resulting in a more reasonable CPUE of 0.53 (sd=.54, n=15) for the Black River and 0.43 (sd=.65, n=33) for the Kouchibouguac River. Overall, 48% of anglers caught nothing; 65% caught less than 0.5 trout per hour and 85% less than 1.0 trout per hour. The best CPUE for the season was 2.4 and only 7 anglers had CPUEs of over 1.0. Some highlights were: 10 anglers fished at the Kouchibouguac River bridge for 59.25 hours for 4 trout on April 25th. On April 30, ten anglers fished 41 hours for 7 trout. Angling was better by early May when 4 anglers fished for 15 hours and caught 12 trout. The peak was on May 14 when 3 anglers fished for 9.5 hrs and caught 11 trout (CPUE 1.3).

1992 STRIPED BASS SURVEY

During August and September a striped bass angling survey was conducted at the Black and Kouchibouguac Rivers. Fourteen anglers were surveyed over the period. Catches ranged from 0.5 to 4.0 bass per hour. The mean CPUE was 1.82. Fifty-five bass were measured ranging from 16.7 cm to 40.7 cm. The mean fork length was 27.5 cm. The main participants were local anglers who casted lures from shore or trolled and casted from boats starting in mid August. By the end of September, catches dropped off. Most bass were retained at the time of this survey.

1996 SURVEY RESULTS

In 1996, 131 interviews were conducted between May 1st and May 20th (the peak of the trout fishing success). Ninety-one records came from the Kouchibouguac River, 19 from the Fontaine River and 5 from the Black River. Sixty different license holders were surveyed and all were local residents. This represented 60 successful fishing trips. No salmon were recorded in the survey, however, 110 trout and 1 striped bass were recorded; all except 4 trout and the bass were retained. For all areas surveyed, total hours were 427.3; total catch of trout was 112 for a CPUE of 0.26. For the Black River the CPUE was 0.67 (sd=.58, n=3); for the Kouchibouguac River the CPUE was 0.32 (sd=.55, n=116). Of the 60 license holders interviewed, 36 were interviewed once, 13 twice, 7 three times, 3 four times, 1 eight times and 1 ten times. The shortest trip was 18 minutes while the longest trip was 9 hours. The average length of a fishing trip was 4.75 hrs. Overall, 52% of anglers caught nothing, 75% caught less than 0.5 per hour, 92% caught less than 1 trout per hour. The best CPUE was 4.4 and 9 trips had CPUEs of greater than 1 trout per hour. Data were kept on tides and wind directions in 1996. Most angling occurred on the falling tide (16 of 137 trips on rising tide). The CPUE on falling tides was worse (0.34) however, than for rising tides (0.42). Better CPUEs were also recorded on sunny days with the wind from the NW to SW (CPUE= 0.5, n=39) than for cloudy days with S to E winds (CPUE= 0.2, n=42).

4.5 Catch and Effort Monitoring

CPUE Analysis of Variance

A marginal means comparison of trout caught per hour (CPUE) between years was performed. The Mean CPUE for 1990, 1991, 1992 and 1996 was 0.38 (n=42); 1.0 (n=69); 0.46 (n=48) and 0.33 (n=119). The CPUE was significantly better in 1991 than in other years. A further means comparison between CPUE for all years combined but separated by location was performed. For all years the mean CPUE of individual anglers on the Black River was 0.91 (n=72) while that for the Kouchibouguac River was 0.39 (n=206). The Black River had a significantly better CPUE. ($p < .05$; Figure 4). The mean CPUE was better on the Kouchibouguac River in 1991 than in the other three years, and the high CPUE (1.2) on the Black River in 1991 was responsible for the statistically significant difference in 1991. There was no significant difference in CPUE among 1990, 1992 and 1996.

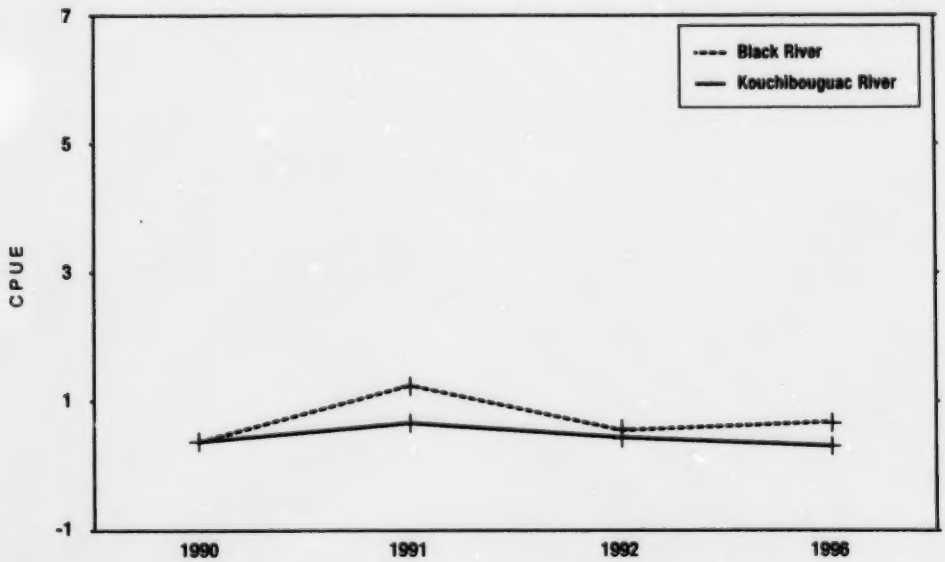

Figure 4. CPUE for the Black and Kouchibouguac Rivers for the years 1990, 1991, 1992 and 1996.

4.5 Biological Analysis

Mean length Statistic

A total of 342 brook trout were measured from the tip of the nose to the fork in the tail (fork length) during the 1991, 1992 and 1996 survey years (Figure 5). The Mean fork length for the sample was 22.1 cm (sd=4.9); the shortest fish was 12 cm. and the longest was 39 cm.

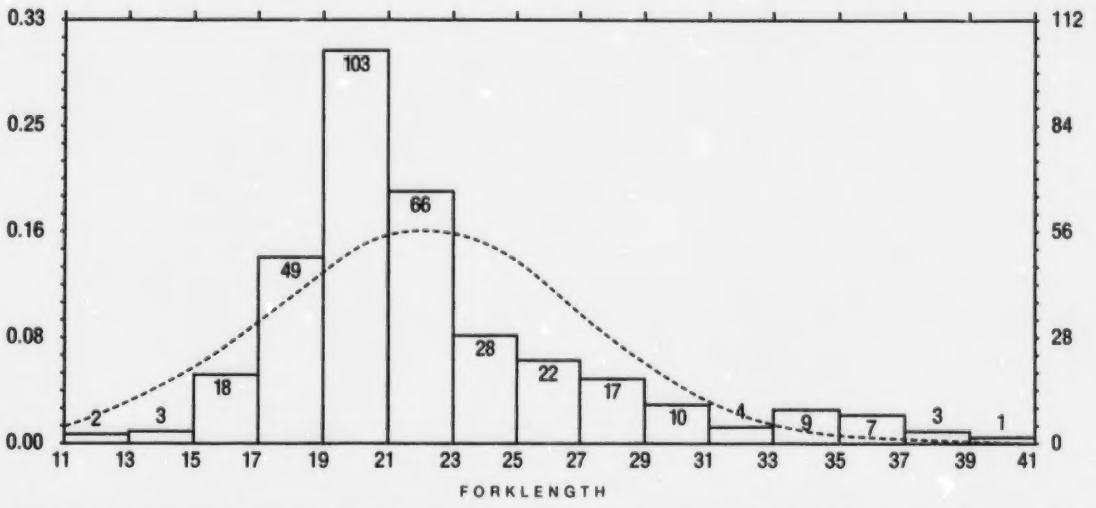

Figure 5. Length frequency distribution of brook trout, Kouchibouguac National Park, for the years 1991, 1992 and 1996.

Fork Length Analysis of Variance

A marginal means comparison of mean length between years (all rivers) was performed. The mean fork length of all trout in 1991, 1992 and 1996 was 21.7cm (n=151), 21.5cm (n=92) and 23.5cm (n=99). Although mean fork length was significantly longer in 1996 than in either 1991 or 1992, the result was biased by the fact that only 3 samples from the Black River were obtained in 1996. Black River trout were significantly shorter than Kouchibouguac River trout (Figure 6).
If only Kouchibouguac River trout are tested (1991: χ=23.52, sd=5.42, n=45; 1992: χ=22.51, sd=6.36, n=66; 1996: χ=23.64, sd=4.4, n=96), there was no significant difference in fork length between years. A marginal means comparison was performed on data for all three years between locations (Black River vs Kouchibouguac River). Mean fork length in the Black River was 20.5 cm (n=135) while that for the Kouchibouguac River was 23.2 (n=207). Mean fork length was significantly longer ($p < .05$) in the Kouchibouguac River (Figure 6).

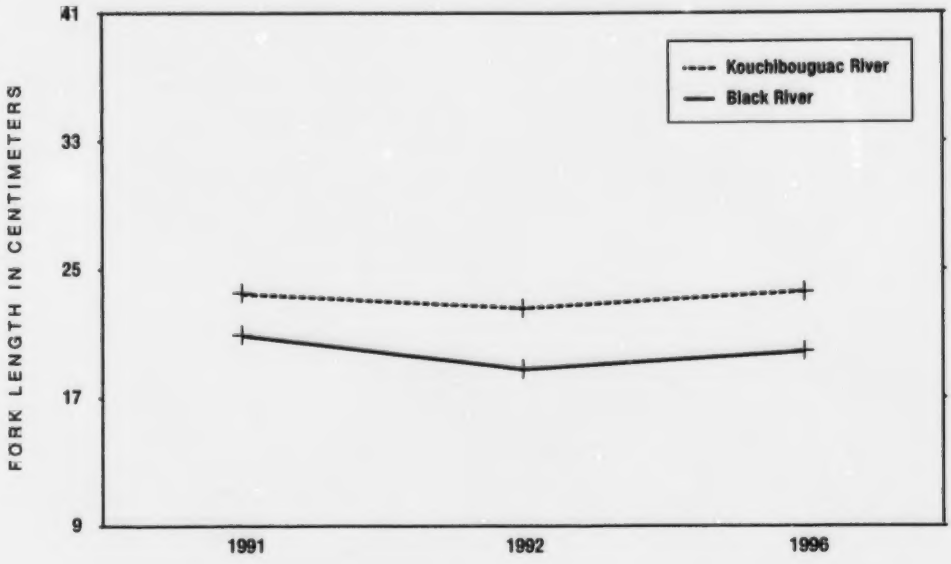

Figure 6. Mean fork length of brook trout in the Black and Kouchibouguac Rivers for the years 1991, 1992 and 1996 .

Age Class Distribution

The ages of 149 trout were determined. Seventy percent of the trout sampled were three year (3+) old fish; twenty-three percent were age 4+, four percent were 2+ and three percent were 5+ (Figure 7).

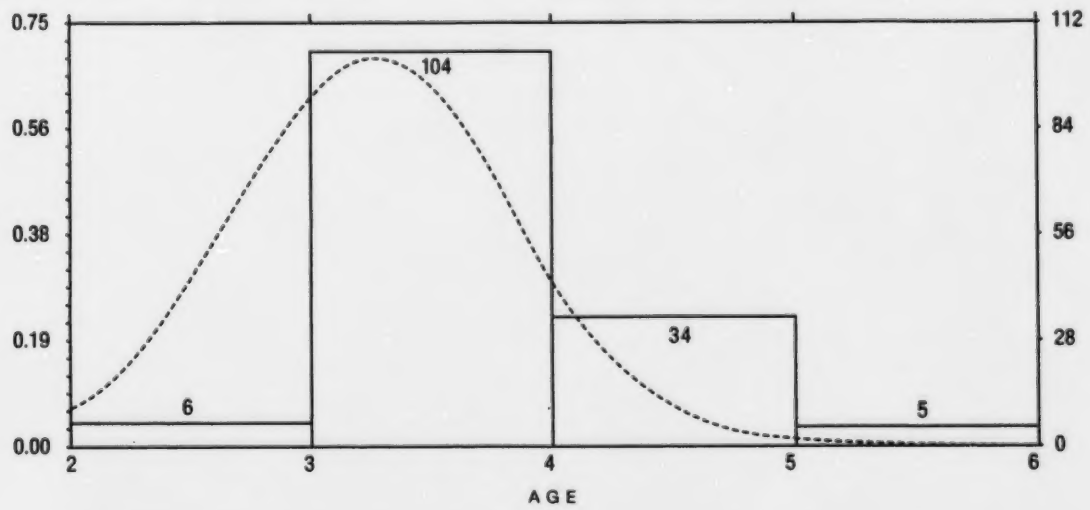

Figure 7. Distribution of trout ages, Kouchibouguac National Park, for years 1992 and 1996.

Independent Group t-tests

Insufficient data were obtained from the Black River, however, sufficient samples of age, fork length and weight were obtained from the Kouchibouguac River in 1992 and 1996 to permit some analysis. Mean age of trout in the catch were compared for the two years (1992: χ=3.24, sd=.54, n=38 1996: χ=3.22, sd=.60, n=96). No significant difference in the mean age of trout caught could be found between 1992 and 1996. Similarly, no significant difference could be found between mean fork length or mean weight between years. The mean weight of trout caught in 1992 and 1996 was 164.4g and 155.1g respectively. The lightest trout weighed only 20 g while the largest weighed 1086g. Fifty percent weighed less than the median weight of 105g., seventy-five percent weighed less than 165g and 90% weighed less than 325g.

Length at Age

Sample sizes were sufficient to establish size ranges for age 3+ and 4+ trout. The Pearson's r (correlation coefficient) was 0.93. Most trout of age 3+ ranged between 17 and 25 cm fork length and trout of age 4+ range between 22 and 37 cm. Few age 2+ or age 5+ fish were sampled (Figure 8).

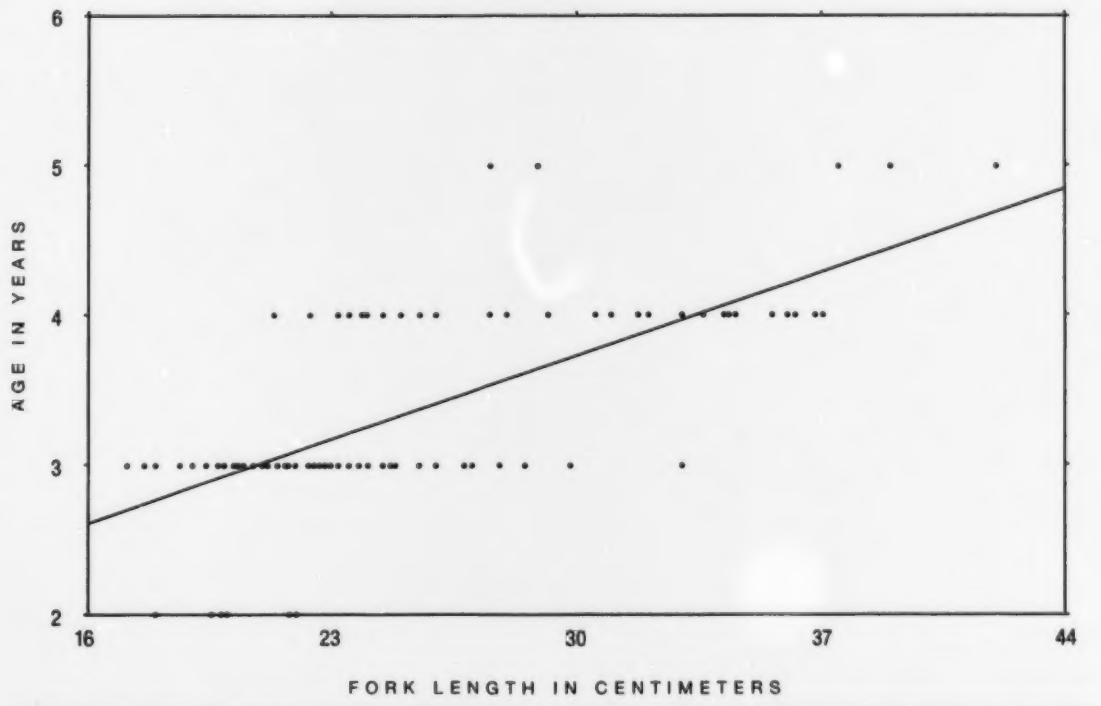

Figure 8. Trout length at age, Kouchibouguac River.

Condition Factors

One means of monitoring the health of fish populations is to look at the condition of individual fish. Since most anglers do not eviscerate their fish until they are home, accurate whole fish weights and fork lengths were obtained. A simple way to assess condition is to compare the length to the weight of each fish. These data can be graphed and compared from year to year. Figure 9 is a scatterplot of trout weights versus their lengths for the Kouchibouguac River for the years 1992 and 1996 compared. An analysis of covariance concluded that 1992 trout were significantly heavier at various fork lengths than 1996 trout (p=.01).

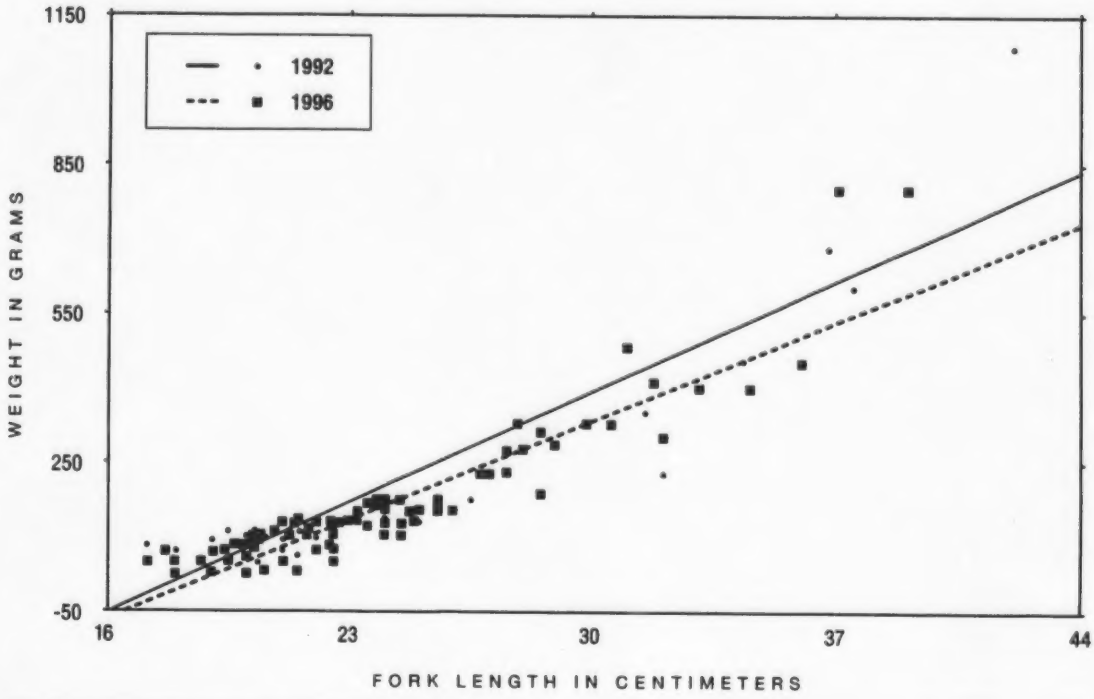

Figure 9. Trout length versus weight, Kouchibouguac River.

5.0 Discussion and Conclusions

The 1990, 1991, 1992 and 1996 angler surveys documented a recreational trout fishery involving predominately local residents. Most successful trout anglers fished from mid April until mid June. The favored locations were the river sections from just above to below the highway 117 bridges that cross the Black and Kouchibouguac Rivers. Some fishing occurred on the Portage River, Fontaine River and Rankin Brook, however, sample sizes were too small for analysis. On average, 425 fishing licenses were sold annually over the 1990-1995 period; sales increased in 1996 when licenses were also required for clam digging. Sixty-five percent of sales were to local residents with approximately 150 licenses bought by tourists that fished after mid June and through the summer. Most local anglers have a favored location. The majority of trout anglers fished from the river banks using spinning gear and hooks baited with worms although some lures were used. The favored time of day to angle was governed by the tide. Most anglers preferred the falling tide even though the success rate was better on the rising tide ((CPUE: .42 vs .34). More anglers fished on sunny days and success was better during those times. The 1996 survey showed a mean CPUE of 0.50 for angling on sunny days with the wind out of the NW to SW and only 0.20 for cloudy days with the wind out of the S to E.

Both freshwater and sea run brook trout were caught in tidal waters. The sea run fish tended to be heavier for any given length and exhibited more silvery coloration. A number of other fish species were also caught, either intentionally or as by-catch. During April and early May, Atlantic salmon ascend and descend the park rivers and a few were caught either as "black" salmon (descending to the sea after wintering in the river) or returning salmon ascending the rivers. These fish were usually released back into the river after capture. Other species caught in mid water included rainbow smelt. Many fishermen used hooks baited with earthworms; when these hooks lie on the river bottom, they may be taken by white sucker, eel, tomcod and flounder (in tidal waters).

The sample size and timing of the survey varied between survey years. Data collected in 1990 was insufficient for analysis but was used to plan subsequent surveys. Random sampling was used but was not stratified as is common in creel census because fishing pressure did not appear to be higher on weekends compared to weekdays. Three hundred and sixty-two interviews in 1991, 106 in 1992 and 131 in 1996 were conducted. These represented more than the minimum sample of 6-15 days per month recommended by Meredith and Malvestuto (1991) to reduce relative standard error to 10% in smaller fisheries. Because catches varied so much from day to day due to weather, timing of the run, tides and individual angler skills, measures of total effort and total catch were impossible to accurately estimate.

The percentage of anglers who caught more than 1.0 trout per hour is a good indicator of angling success. The 1991 trout season was the best of the 4 years; 31% of anglers caught more than 1.0 trout per hour. In 1992, 15% caught more than 1.0 and in 1996, 8% caught more than 1.0. The percentage of anglers who caught no fish can also be a useful indicator (Bannerot and Austin 1983). In 1991, 18% caught no fish while in 1992, 48% caught nothing and in 1996, 52% caught nothing. This would seem to suggest that trout abundance was greater in 1991 than in the other years. Some exceptionally good fishermen can make great catches in poor years. One angler had a CPUE of 4.4 in 1996. Overall, the best angling (1.2 trout per angler hour) was experienced in 1991 on the Black River. Success was also better on the Kouchibouguac River in 1991 than in the other years. ANOVA revealed that CPUE was significantly higher in 1991 than in the other three seasons, but further testing revealed no significant difference in CPUE between 1990, 1992 and 1996 (Figure 4). No decline in catch can be shown statistically at the present time and there are no grounds to change the angling regulations. The 1991 season could have been an anomaly when a strong year class of trout was in the area or tides and weather where particularly favorable. Further tests revealed that

over all four years, anglers on the Black River had significantly better CPUE than those fishing the Kouchibouguac River. We questioned why more anglers fish on the Kouchibouguac River than the Black River. An ANOVA was performed on the mean fork length of trout captured in the Black River compared to those caught on the Kouchibouguac River. It was found that Kouchibouguac River trout are significantly longer than Black River trout and may be a factor in anglers choice of location (Figure 6). Other factors may include the greater possibility of catching salmon on the Kouchibouguac River.

A useful statistic to monitor the health of fish populations is the mean length of all fish of the same species caught. The assumption is that over-fished populations will exhibit lower mean length because anglers remove the larger fish. ANOVA was performed on fork lengths from 207 trout measured in 1991, 1992 and 1996. No significance difference in mean length could be found between years leaving no rationale for regulation changes at this time (Figure 6). Age data are available only for the 1992 and 1996 years. During both years the majority of trout caught were 3 year olds and there was no significant difference between years. The length of trout in each age class were examined. Kouchibouguac River trout were found to average between 17 to 25 cm at age 3 and 22 to 37 cm at age 4. Overlap in lengths between age classes could have been due to the degree of time in salt water spent by individual trout. When trout go into estuaries or to sea they grow at much greater rates due to greater abundance of food. Shorter trout in any given age group may have spent less time in salt water and may overlap the length of trout in a younger age class that have been to sea. This was consistent with Scott and Crossman (1973) reporting sea-run trout in the Moser River (Nova Scotia) at 24.7 cm at age 3 and 27.4 cm at age 4. Freshwater specimens were only 17.8 and 22.4 cm at those ages. The comparison of weight at a given fork length was more interesting. A scatterplot and analysis of covariance were performed. It was found that in the Kouchibouguac River, trout of any given length were heavier in 1992 than in 1996. This could mean that more and better food was available to trout in 1992, that the population was healthier, overall, or that more sea-run trout were in the catch.

A striped bass catch census was conducted in 1992. Bass were caught between mid August and late September in both rivers. Lure casting from the shore or trolling from boats was employed. Success was excellent with a mean catch per hour of 1.82. Fifty-five bass were measured; the longest was 40.7 cm and the smallest was 16.7 cm. The mean fork length was 27.5 cm. The fishery was employed mostly by local anglers however four Americans and one Nova Scotian were surveyed. Insufficient creel census data were available to evaluate either the striped bass or the Atlantic salmon populations in either river system.

Overall, the trout fishery in Kouchibouguac NP appears to be healthy and sustainable. There are no indications of a decline at this time. Little creel census data from similar fisheries (sea-run) in the Maritimes exists, however, authors personal knowledge indicates that the quality of angling in late April to mid June is as good as anywhere in Maritime Canada. Nicholas (1996) presents creel census data for Kejimkujik NP (1994-1996) in Nova Scotia. The fishery there is solely freshwater and comparisons are limited however CPUE, average age of trout caught, mean fork length and weight are within the range of the Kouchibouguac River fishery.

6.0 Recommendations

Although many people may not agree with sportfishing in national parks, the reality of it is that without angling and the surveys that usually monitor it, we might not have any monitoring of fish communities. Moyle (1994) states that protecting ecosystems requires the development of ways to monitor ecosystem health; the most effective ways seem to revolve around monitoring assemblages of organisms within the ecosystem and in freshwater systems this usually means fish. Angler survey and catch census provide important data, not only on the harvest species populations themselves but also on by-catch species. The early detection of introduced or exotic species may be particularly valuable knowledge.

* Another angler survey in Kouchibouguac NP should be implemented in 2001, a five year period since the last survey in 1996. Future surveys should place more emphasis on surveying evening angling activity which was lacking in past surveys. Future surveys should also census what summer tourists are fishing for and how successful they are. The 2001 survey should strictly adhere to the methods outlined in Pollock, Jones and Brown (1994). Consideration should also be made for collecting additional data on the variety of trout caught (sea-trout vs freshwater in catches) angler attitudes, economic expenditures, expanding on weather data to include barometric pressure readings, water temperatures and chemistry data. A custom computer software program to handle data inputs and deliver automated outputs in CPUE, mean length, etc. would improve efficiency and speed information requirements for management actions as required.

* Data on CPUE are non-normally distributed and it is usually considered inappropriate to use parametric analytical methods. Simple non-parametric tests, however, are of lower statistical power and the results could be distorted by the large number of zero (0) CPUE values (Cryer and Maclean 1991). An alternative approach might be to employ a multi-dimensional contingency table analysis which would not depend on assumptions about the distribution of data (Bishop et al. 1975).

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Appendix I

Data compiled and used in the statistical analysis within this report:

Name of database:	Digital Filename:	Contents:
Trout age data 1992 & 1996	troutage.dbf	Year data taken Location of each fish Scale age of each trout Fork length of each fish
Catch per unit of effort data (CPUE)	troutcpu.dbf	Year data taken Location of each sample Calculated CPUE of each Sample
Fork length (cm) of trout sampled	troutfl.dbf	Year data taken Location of each sample Fork length of each fish
Weight (g) of trout sampled	troutwt.dbf	Year data taken Location of each sample Scale age of each fish Fork length of each fish Weight of each fish

Parcs Canada, région de l'Atlantique, produira trois séries de rapports en sciences des écosystèmes afin de communiquer de nouvelles données scientifiques, de consigner des données scientifiques, et de résumer les connaissances existantes ou de formuler des recommandations d'ordre technique. La fonction principale et le public visé détermineront la série dans laquelle un rapport sera publié. Chaque série contiendra des informations scientifiques et techniques qui viendront enrichir les connaissances existantes, mais ne pourraient être publiées dans les revues professionnelles en raison de leur présentation.

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Rapports en sciences des ecosystèmes sont publiés dans la langue officielle choisie par l'auteur en fonction du public visé, avec un résumé dans la deuxième language officielle.

Objectifs
Ces séries de rapports serviront à :

- communiquer les résultats des recherches effectuées en sciences des écosystèmes aux scientifiques et aux gestionnaires, ainsi qu'aux membres du public que les activités enterprises par Parcs Canada en écologie et en conservation intéressent.
- offrir des publications professionnelles, crédibles et précises qui seront soumises à l'évaluation par les pairs.
- favoriser la diffusion de l'information, la créativité, l'efficacité et le travail d'équipe dans les projets de recherche.

Évaluation par les pairs
Le rédacteur nommera deux lecteurs choisis, dans la mesure du possible, parmi le personnel scientifique de Parcs Canada, qui seront chargés de faire une critique de chaque manuscrit. On fera appel à des lecteurs de l'extérieur en raison de l'expertise exigée, du temps disponible et de l'objectivité nécessaire. Les lecteurs renverront le manuscrit au rédacteur en y joignant leurs commentaires par écrit. Le rédacteur renverra le manuscrit à son ou à ses auteurs avec les commentaires des lecteurs. L'auteur prendra connaissance des commentaires et tiendra compte de ceux avec lesquels il est d'accord, puis il retournera le manuscrit révisé au rédacteur en lui expliquant par écrit pourquoi il n'a pas tenu compte de certains commentaires. Le rédacteur enverra ensuite le manuscrit au garde de parc en chef, ou, s'il s'agit d'employés du bureau régional, au superviseur immédiat de l'auteur, pour faire approuver la publication et l'impression du manuscrit. Dans le cas de publications de moindre importance, le rédacteur peut, à sa discrétion, décider de ne pas avoir recours à des lecteurs; lui-même et le superviseur immédiat de l'auteur serviront alors de lecteurs. En cas de désaccord entre l'auteur et le rédacteur au sujet du manuscrit, c'est le gestionnaire ministériel principal qui tranchera.

Directives à l'intention des auteurs
Ces séries de rapports seront consacrées à la publication de travaux effectués dans la région de l'Atlantique en science des écosystèmes et seront mises à la disposition de tous les employés de Parcs Canada, du ministère du Patrimoine canadien, de leurs collaborateurs ou de toute personne qui travaille pour le compte de Patrimoine canadien.

Les auteurs soumettront au rédacteur régional une copie de leur manuscrit sur support en papier, une version sur disquette en WordPerfect Windows ou DOS et le nom de trois lecteurs éventuels qui ne connaissent pas le manuscrit.

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Neil Munro
Rédacteur des séries de Rapports
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